

DESCRIPTION

## TWO-SHAFT HINGE MECHANISM ENABLING HARNESS WIRING

TECHNICAL FIELD OF THE INVENTION

[0001] The present invention relates to two-shaft hinge components which are used in a folding/rotating mechanism part on a small electronic device such as cellular phones, notebook computers, electronic organizers, DVD monitors, and remote controllers.

BACKGROUND ART OF THE INVENTION

[0002] ~~In most~~ Conventionally, rotation friction torque generation mechanisms on a torques of opening/closing shafts and a rotation shafts of conventional two-shaft hinges, are generated in most cases by mechanisms employing structures in which of a plate member wraps wrapping around a shaft or structures of a pressed disc spring is pressed to generate rotation friction torque (see Patent Document 1).

[0003] Fig. 16 shows an example of a conventional two-shaft hinge. ~~Plate~~ a plate spring 54 formed into a wave-like shape ~~or the like and~~ a bracket 56 are fixed onto each side of a supporting plate 52 of a pressed opening/closing shaft by means of a fixing flange 53. ~~Rotation~~ a rotation shaft 57 is fixed with piercing pierces through a center portion of the supporting plate 52 of the opening/closing shaft, ~~and at the center thereof.~~ A rotational torque is generated provided by a method of pressing friction of a pressed plate spring 59.

[0004] In the conventional hinge, ~~not only~~ a rotating angle stopper mechanism is not provided, but also and thus a torque is generated by ~~a method of pressing a friction plate by using that uses the repulsive force of a disc spring, thus problems that friction caused on.~~ This leads to problems

such as wear of the supporting plate 52 and the bracket 56, and, a free-play, and looseness and deterioration of durability due to deformation (~~permanent strain~~) of the plate spring 54 arise, and low mechanical durability. The fluctuation in torque or deterioration of durability ~~which is involved in change within~~ time ~~causes~~ causes degrading of the quality of the device and a breakdown of the device. In the latest two-shaft hinges, compared to the conventional hinges, the operability and feelings in opening/closing and rotating are ~~regarded~~ required, and thus a mechanism ~~to limit for~~ limiting the rotating angle and opening/closing angle, ~~maintenance of~~ and a stable torque value, high durability, and reduction in size and weight are strongly demanded.

#### DISCLOSURE SUMMARY OF THE INVENTION

[0005] The ~~problem to be solved by the present invention is to provide~~ provides two-shaft hinge components which enable harness wiring by using a hollow rotation shaft and thereby realize durability, and reduction in size and weight in cellular phones, or notebook computers ~~or the like~~ in which ~~further~~ continuing reduction in size and weight is demanded. Patent Document 1: Japanese Patent Publication No. 2002-155923

#### MEANS TO SOLVE THE PROBLEMS

[0006] The ~~present invention is constituted as described hereinafter.~~

—The ~~present invention described in claim 1 obtains a two-shaft hinge having a rotation shaft and an opening/closing shaft,~~ two-shaft structure comprising: a rotation shaft; an opening/closing shaft; a rotation torque unit in which a plurality of rotation torque generating portions are provided on the rotation shaft, the rotation torque generating ~~portion~~ portions being assembled by putting

a first coil spring around an outer periphery of the rotation shaft having a penetrating hole and by abutting a first fixing cam and a first rotating cam on both ends of the first coil spring; and an opening/closing torque unit in which a plurality of opening/closing torque generating portions are provided on the opening/closing shaft, the opening/closing torque generating ~~portion~~portions being assembled by putting a second coil spring around the opening/closing shaft and by abutting a second fixing cam and a second rotating cam on both ends of the first coil spring~~+, wherein, the two-shaft hinge has a two-shaft structure in which~~ an axial direction of the rotation shaft and an axial direction of the opening/closing shaft are assembled to a hinge housing to be perpendicular to each other, the hinge housing has a hole through which the rotation shaft pierces, the torque units ~~which generate a sliding torque and a click torque at a rotation, and an~~ opening/closing ~~operation~~operational function on the rotation shaft and the opening/closing shaft, ~~and the opening/closing torque unit is assembled to either right or left side or both right and left sides of the rotation torque unit, and a hole through which a harness wiring can pass is provided on the other side of the rotation torque unit in the hinge housing.~~

[0006.1] ~~Here, the respective~~The axis lines of the axial direction of the rotation shaft and of the axial direction of the opening/closing shaft are perpendicular to each other, but do not necessarily intersect with each other.

[0007] ~~The~~Another embodiment of the invention ~~described in claim 2 obtains a two-shaft hinge having a rotation shaft and an opening/closing shaft~~two-shaft structure, comprising: a rotation shaft; an opening/closing shaft; a rotation torque unit in which a pair of rotation torque generating portions is provided on the rotation shaft, the rotation torque generating ~~portion~~portions being assembled by putting a first

coil spring around an outer periphery of the rotation shaft having a penetrating hole and by abutting a first fixing cam and a first rotating cam on one end of the first coil spring; and an opening/closing torque unit in which a plurality of opening/closing torque generating portions are provided on the opening/closing shaft, the opening/closing torque generating ~~portion~~portions being assembled by putting a second coil spring around the opening/closing shaft and by abutting a second fixing cam and a second rotating cam on both ends of the second coil spring~~+, wherein, the two-shaft hinge has a two-shaft structure in which~~ an axial direction of the rotating axis and an axial direction of the opening/closing shaft are assembled to a hinge housing to be perpendicular to each other, and the hinge housing has a hole through which the rotation shaft pierces, the torque units ~~which generate a sliding torque and a click torque at a rotation,~~ and an opening/closing operations function on the rotation shaft and the opening/closing shaft, ~~and the~~ opening/closing torque unit is assembled to either right or left side ~~or both right and left sides~~ of the rotation torque unit, and a hole through which a harness wiring can pass is provided on the other side of the rotation torque unit in the hinge housing.

**[0008]**      ~~The invention described in claim 3 is~~ A third embodiment of the two-shaft hinge according to claim 1 or claim 2, wherein the sliding torque and the click torque are generated by abutting the fixing cam and the rotating cam in the has an additional feature that the rotation torque unit is assembled on the rotation shaft, a plurality of the rotation torque generating portions provided are assembled on the rotation shaft, and torque unit, and have torque generating operations, to generate the sliding torque and the click torque by abutting the first fixing cam and the first rotation cam, the torque generating operations are different

and independent to one another by combining the first fixing cam and the first rotation cam having different positions of a concave groove (~~eoneave~~) and a convex protrusion (~~econvex~~) of the cams used by the rotation shaft~~first fixing cam and the first rotating cam or by pair and/or a~~combining different numbers of the cams are combined, whereby the ~~rotation torque unit which incorporates with the plurality of rotation torque generating portions having different torque generation operations is formed, and the torque unit is assembled on the rotation shaft. Whereby, the two-shaft hinge that shows a more complex rotation torque is thereby realized.~~

**[0009]** ~~The invention described in claim 4 is~~A fourth embodiment of the two-shaft hinge according to claim 1 and claim 2, wherein the sliding torque and the click torque are generated by abutting the fixing cam and the rotating cam~~in~~has a feature that the opening/closing torque unit is assembled on the opening closing shaft, a the plurality of the opening/closing torque generating portions provided are assembled on the opening/closing shaft, and~~torque unit and have torque generating operations to generate the sliding torque and the click torque by abutting the second fixing cam and the second rotating cam, the torque generating operations are different and independent to one another by combining the second fixing cam and the second rotation cam having different positions of a concave groove (~~eoneave~~) and a convex protrusion (~~econvex~~) of the cams~~second fixing cam and the second rotation cam used by the opening/closing shaft~~or by pair and/or a~~combining different numbers of the cams are combined, whereby the ~~opening/closing torque unit which incorporates with the plurality of opening/closing torque generating portions having different torque generation operations is formed, and the torque unit is assembled on the opening/closing shaft. Whereby, the two-shaft hinge that~~

shows a more complex opening/closing torque characteristics thereby is realized.

[0010] ~~The invention described in claim 5 is~~ A fifth embodiment of the two-shaft hinge according to claim 1 and claim 2, wherein a part of has a feature that a cross-section of a part of the rotation shaft and the opening/closing shaft is other than a circle, or is formed to be a quadrangle or to have a shape having a major axis and a minor axis, which is other than a circle, and the rotation shaft and the opening/closing shaft having a shape which allows allowing the first and the second fixing cams for rotation and opening/closing, which are used respectively in the rotation torque generating portions and the opening/closing torque generating portions, to move respectively in an the axial direction of the rotation shaft and the axial direction of the opening/closing shaft, but which inhibits them inhibiting the first and the second fixing cams from rotating on a periphery of with respect to the rotation shaft, are employed.

[0011] ~~The invention described in claim 6 realizes~~ A sixth embodiment of the two-shaft hinge according to claim 1 and claim 2, wherein includes a stopper mechanism to restrict a rotation angle and an opening/closing angle of the rotation shaft and the opening/closing shaft is mounted so that a rotation range ranges of the rotation shaft and the opening/closing shaft is are restricted.

[0012] ~~The invention described in claim 7 realizes~~ A seventh embodiment of the two-shaft hinge according to claim 1 and claim 2, wherein includes a disc spring, a waved plate spring, or a thin plate spring is employed in place of the first and the second coil springs springs which generate generate an abutting force in the torque generating portions used in the rotation torque unit and the opening/closing torque unit, so that in order to reduce the size is reduced of the two-shaft hinge.

[0013]        ~~The invention described in claim 8 realizes~~An eighth embodiment of the two-shaft hinge according to claim 1 and claim 2, wherein ~~a penetrably holed shaft~~ the rotation shaft has the penetrating hole in which a through-hole is provided at a center of the rotation shaft ~~is used,~~ in order to enable ~~at~~ the harness wiring.

[0014]        ~~The invention described in claim 9 is~~A ninth embodiment of the two-shaft hinge according to claim 1 and claim 2, wherein has a feature that a case for the rotation shaft and a case for the opening/closing shaft in each of which an outer periphery thereof ~~partially~~ has a groove or a deformed cross-section other than a circle, are fitted with or fixed to the first and the second rotating cams in each of which an outer periphery thereof has a protrusion or a deformed cross-section, in order to effectively transmit a sliding torque force and a click torque force, which are generated in the first and the second rotating cams used on the rotation shaft and the opening/closing shaft, to the hinge housing. ~~Whereby,~~ A reduction in size, improvement in strength, and improvement in durability can be thereby achieved.

[0015]        ~~The invention described in claim 10 is~~A tenth embodiment of the two-shaft hinge according to claim 1 and claim 2, wherein has a feature that the first rotating cam used in the rotation torque generating ~~portion~~ portions is configured to be ~~another member as~~ a bottom portion to which the rotation torque unit is fitted and attached in the hinge housing. ~~Whereby, reduction in a,~~ to reduce the number of components, ~~reduction in and~~ size, and ~~improvement in~~ improve the strength of the hinge housing ~~can be achieved.~~

[0016]        ~~The invention described in claim 11 realizes~~An eleventh embodiment of the two-shaft hinge according to claim 1 and claim 2, wherein has a feature that the rotation torque unit and the opening/closing torque unit are assembled as an

independent unit, ~~thereafter they~~ and the torque units are fitted and attached to or screwed into the hinge housing in which a means for fitting or screwing to fix is provided in advance.

[0017] ~~The invention described in claim 12 is~~ A twelfth embodiment of the two-shaft hinge according to claim 1 and claim 2, wherein, for mounting and fixing the two-shaft hinge to a device chassis, includes a fixing base component adhered to the rotation shaft is added and for mounting and fixing the two-shaft hinge to a device chassis, wherein the two-shaft hinge is fixed by the base, whereby the device chassis is designed easily component.

[0018] ~~The present invention of claim 1 can realize~~ realizes a highly durable two-shaft hinge which has excellent durability because it employs a plurality of cam mechanisms to stably and securely achieve generate a sliding torque and a click torque in the torque generation mechanisms on of the rotation sideshaft and the opening/closing side of the two-shaft hingeshaft. This invention ~~shows a large effect in significant reduction of~~ significantly reduces the number of components and ~~reduction in the~~ size of the two-shaft hinge. This invention also ~~exerts an effect that enables harness (cable)~~ cable wiring by making the center of the rotation shaft hollow.

[0019] ~~The invention of claim 2 can realize~~ second embodiment realizes a highly durable two-shaft hinge which has excellent durability because it employs a pair of torque generation mechanisms on the rotation sideshaft and a plurality of torque generation mechanisms on the opening/closing sideshaft to stably and securely achieve generate the sliding torque and click torque. This invention ~~exhibits a large effect in significant reduction of~~ significantly reduces the number of components and ~~reduction of the size of the two-shaft hinge.~~ This invention

also ~~shows an effect that enables~~ harness ~~(cable)~~cable wiring by making the center of the rotation shaft a penetrating hole.

[0020]        The ~~inventions of claim 3 and claim 4 exert an effect that generates complex~~third and the fourth embodiments generate the sliding torque and the click torque by incorporating cams operating differently in theproviding a plurality of the cam mechanisms which are mounted in at the rotation and the opening/closing torque generating portions\_ with each cam having different operation pattern.

[0021]        The ~~invention of claim 5 is to ensure~~fifth embodiment ensures a stable operation of the fixing cams for the rotation shaft and the opening/closing shaft, and thus ~~shows a large effect in~~contributes to preventing the feeling of looseness and free-play.

[0022]        The ~~invention of claim 6~~sixth embodiment exerts an effect of obtaining a two-shaft hinge which restricts the ~~range of rotating angle by mounting a stopper on the rotation and the opening/closing shafts.~~

[0023]        The ~~invention of claim 7 exerts an effect that~~seventh embodiment enables a reduction of the size of the two-shaft hinge by employing a disc spring, ~~and~~a waved plate spring, or a thin plate spring instead of the coil spring.

[0024]        The ~~invention of claim 8 exhibits an effect that~~eighth embodiment enables harness ~~(cable)~~cable wiring by providing a penetrating hole which penetrates through the center of the rotation shaft.

[0025]        The ~~inventions of claim 9, claim 10, and claim 11 exert an effect which contributes~~ninth, the tenth and the eleventh embodiments contribute to improving the torque transfer characteristic, prevention of apreventing free-play, ~~improvement and improving in strength,~~ and productivity of unit assembling units, and even ~~enables~~enable a reduction in size of the two-shaft hinge.

**[0026]**        ~~The invention of claim 12 exerts an effect that~~  
~~makes designing of the two shaft hinge and attaching it~~  
~~to~~twelfth embodiment enables easy designing and firm  
attachment of the device easy and firm by employing a  
technique of a fixing base.

#### BRIEF DESCRIPTION OF THE DRAWINGS

**[0026.1]**        Figure 1 is a partial cross-sectional front view  
showing an example of the first, the eighth and the twelfth  
embodiments.

**[0026.2]**        Figure 2 is a component configuration diagram  
showing an example of the first, the fifth, the sixth and the  
eleventh embodiments;

**[0026.3]**        Figures 3(a), 3(b), 3(c), 3(d) and 3(e) are,  
respectively, a top view, a front view, a bottom view, a left  
side view, and a right side view;

**[0026.4]**        Figure 4 is a partial cross-sectional front view  
showing the seventh embodiment;

**[0026.5]**        Figure 5 is a partial cross-sectional front view  
showing the third embodiment;

**[0026.6]**        Figures 6(a), 6(b), 6(c), 6(d) and 6(e) are  
componential drawings of the fixing cams of the rotation and  
the opening/closing torque generating portions;

**[0026.7]**        Figures 7(a), 7(b), 7(c) and 7(d) are  
componential drawings of the rotating cams of the rotation  
and the opening/closing torque generating portions;

**[0026.8]**        Figures 8(a), 8(b) and 8(c) are componential  
drawings of the rotating cams of the rotation and the  
opening/closing torque generating portions;

**[0026.9]**        Figure 9(a) is a partial cross-sectional view of  
the fourth and the seventh embodiments. The upper portions  
of Figures 9(b), 9(c) and 9(d) are partial plan views of the  
fixing cam and the rotating cam, and the lower portions of

Figures 9(b), 9(c) and 9(d) are cross-sectional views of the same;

[0026.10] Figures 10(a) and 10(b) are a cross-sectional view and a component configuration diagram of the sixth embodiment, respectively;

[0026.11] Figure 11 is an appearance of a hinge housing;

[0026.12] Figures 12(a) and 12(b) are a front view and a top view of the rotation shaft;

[0026.13] Figure 13 is a partial cross-sectional front view of the tenth and the eleventh embodiments;

[0026.14] Figure 14 is a partial cross-sectional front view of the second embodiment;

[0026.15] Figure 15 is a partial cross-sectional front view of the second embodiment; and

[0026.16] Figure 16 is a front view of an example of a conventional two-shaft hinge.

~~BEST MODE FOR CARRYING OUT THE INVENTION~~ DETAILED DESCRIPTION

[0027] Embodiments of the present invention are described hereinafter with reference to the drawings.

[0027.1] ~~Fig.~~Figure 1 shows a partial cross-sectional front view of an example of the first, the eighth and the twelfth embodiments of claim 1, claim 8, and claim 12 with regard to the two-shaft hinge of the present invention enabling harness wiring. The two-shaft hinge is configured by fitting and attaching a rotation torque unit 22 and an opening/closing torque unit 23 to a hinge housing 9. ~~In~~As shown in the two-shaft hinge ~~shown in Fig.~~Figure 1, from the bottom of a rotation shaft 11 to an opening 22 at the top thereof ~~is~~exists a penetrating hole, through which harness ~~(cable)~~cable wiring for an electrical connection can pass. ~~Rotation~~The rotation shaft 11 and a fixing base 10 in ~~Fig.~~Figure 1 are fitted and fixed to each other, and when attaching the fixing base 10 to a device ~~or the like~~, the

hinge housing 9 can rotate clockwise or counterclockwise around the center of the rotation shaft 11 ~~as the center~~. ~~Torque~~A torque unit 23 for the opening/closing shaft, which is attached to the hinge housing 9, can rotate with respect to the opening/closing shaft.

**[0028]** ~~Fig.~~Figure 2 shows a component configuration diagram of the two-shaft hinge related to an example of the first, the fifth, the sixth and the eleventh ~~embodiments of~~ ~~claim 1, claim 5, claim 6, claim 11 and the like of the~~ present invention. The rotation system ~~is constituted by~~comprises components of, from the bottom of the figure, the rotation shaft 11 having an inside hole, the fixing base 10, the hinge housing 9, a lubricating ring 2, a first rotating cam 8, a first fixing cam 7, a case 6 for the rotation shaft, a first coil spring 5, a second fixing cam 4, a second rotating cam 3, a second lubricating ring 22-1 and a caulking ring 1. The opening/closing system ~~is constituted by~~comprises an opening/closing shaft 12, a third lubricating ring 13, a case 14 for the opening/closing shaft, a third rotating cam 15, a third fixing cam 16, a second coil spring 17, a fourth fixing cam 18, a fourth rotating cam 19, a fourth lubricating ring 13-1, a bracket 20, and a fixing pin 21.

**[0029]** In the two-shaft hinge shown in ~~Fig.~~Figure 2, two pairs of rotation torque and opening/closing torque generating portions are provided on each shaft, attached to the case 6 for the rotation shaft and the case 14 for the opening/closing shaft, and assembled as the rotation torque unit 22 and the opening/closing and torque units ~~unit 23~~. ~~Fig. 2 shows an example~~The assembled as-opening/closing unit 23 is shown in Figure 2.

**[0030]** ~~In the~~The case 6 for the rotation shaft, has grooves 6-1, 6-2 into which ~~after-mentioned protrusions 3-6 and 8-6,~~ on outer peripheries of the rotation cams 3, and 8

are inserted, ~~are provided~~. In the hinge housing 9, a hole 9-6 through which the rotation shaft 11 pierces, a space 9-5 to which the rotation torque unit 22 is fitted and attached, a hole 9-2 to which the opening/closing shaft torque unit 23 is fitted and attached, a protrusion 9-3 to restrict the rotating angle, and a hole 9-1 through which a harness wiring can pass, are provided. ~~Fixing~~The fixing base 10 has, at the center ~~thereof~~, a hole through which the rotation shaft pierces, and protrusions 10-1, 10-2, which abut on the protrusion 9-3 of the hinge housing for ~~the~~ rotation restricting, to restrict the rotation. A rotation range ~~in~~which of the housing portion ~~can rotate~~ in the example of ~~Fig.~~Figure 2 is set to 180°, which allows the protrusion 9-3 of the housing to rotate clockwise from an initial position where it first abuts on the left protrusion 10-1 of the base to a position where it abuts on the right protrusion 10-2.

[0031] ~~The cross-section of opening/closing shaft 12~~ is has a deformed ~~shape, and~~ cross-section such that the cross-sections ~~indicated with~~ for the center portion 12-1 and the bottom portion 12-2 of the opening/closing shaft 12 in ~~Fig.~~Figure 2 are an oval shape. Similarly, the cross-sectional shape of the case 14 for the opening/closing shaft is an oval shape ~~(surfaces 14-1, 14-2)~~, and the outer peripheries of the rotating cams 15, 19 used to be fitted and attached to the inside are partially cut to be an oval as shown in ~~Fig.~~Figures 8(a), 8(b), and 8(c) ~~for use~~. The combinations of the cases 6, 14 and the rotating cams 3, 8, 15, 19 shown in ~~Fig.~~Figure 2 were explained in each of the cases of the grooves and the ovals ~~individually in this example~~, but it can employ either design which is advantageous in terms of the fitting ~~manner~~ formation, the reduction in size, and the strength.

[0031.1] ~~Meta~~A metal or resin can be used as a ~~the~~ material of the components used in the two-shaft hinge of the

present invention shown in ~~Fig.~~Figure 2, and heat treatment, and surface treatment and the like are accordingly carried out accordingly appropriately.

**[0032]** ~~Fig.~~Figure 3 shows a two-shaft hinge according to ~~an embodiment of claim 1, claim 6, claim 8, and claim 12~~the first, the sixth, the eighth and the twelfth embodiments of the present invention, and. Figure 3(a) is a top view, 3(b) is a front view, 3(c) is a bottom view, and, ~~(e)~~3(d) and ~~(d)~~3(e) are side views.

**[0032.1]** In the top view of Figure 3(a), a penetrating hole 11-1 is present at the center of the rotation shaft 11, and, on the left side of the housing 9, a through-hole 9-1 is provided from hole a side portion 9-7 to the end of the housing 9-1. A part of a space 9-5 at the center portion of the housing 9 has a structure of a concave groove 9-8, and the protrusion ~~(3, 8, 15, 19-6)~~ of the rotating cam 3 of the rotation torque unit after-mentioned 22 is fitted and attached to the groove 9-8, whereby the hinge has a structure in which a sliding torque and a click torque ~~(force)~~ of the rotation torque unit 22 are transmitted securely without causing a free-play.

**[0032.2]** The bottom view of Figure 3(c) shows a state ~~that~~where the rotation shaft 11 is fitted and attached to the base 10, and flange 11-5 on the lowest portion of the rotation shaft 11 has a structure square shape to prevent the occurrence of a the free-play in rotation by the square shape. ~~Hole~~A hole 10-2 to fix a device is provided on each of the four corners of the base 10.

**[0032.3]** The left side view of Figure 3(d) shows a state that the shaft through-hole 9-1 and the rotation stopper abut on each other ~~(9-3, 10-1).~~

**[0032.4]** The right side view of Figure 3(e) shows a state that the shape of the case 14 incorporating the

opening/closing shaft 12 and the opening/closing torque unit 23 is oval.

[0033] ~~Fig.~~Figure 4 is an example showing the two-shaft hinge of ~~an~~the seventh embodiment ~~of claim 7~~ of the present invention, ~~and it shows the example in which~~wherein a disc spring is used instead of the coil spring ~~therein~~. An example in which a waved plate spring is used is shown in ~~Fig.~~Figure 9.

[0034] ~~Fig.~~Figure 5 is an example showing the two-shaft hinge of ~~an~~the third embodiment ~~of claim 3~~ of the present invention, ~~and it shows an example in which~~ wherein the fixing cam 4-1 and the rotating cam 3-1 on a lower portion, which are used in the torque generating portion of the rotation shaft, are different from the fixing cam 4 and the rotating cam 3 on an upper portion ~~in terms of~~with regard to the concave groove (~~concave~~) and the convex protrusion (~~convex~~) formed on abutting surfaces. ~~The~~Figures 6-8 show the shape of the cam ~~abutting surfaces can be used by~~ combining. Thus, combination of the fixing cam and the rotating cam ~~shown in Fig. 6, Fig. 7, and Fig. 8, and can be~~ selectedemployed appropriately ~~to employ~~ in accordance with the magnitude and ~~a requested generation~~ the position of the sliding torque and the click torque in rotation and opening/closing operation of the two-shaft hinge.

[0035] ~~Fig. 6 (a), (b), (c), (d) and (e)~~Figures 6(a), 6(b), 6(c), 6(d) and 6(e) show examples of the shapes ~~of~~for the abutting surface of the fixing cam 4, 7, 16, 18 for the rotation torque generation and the opening/closing torque generation, which are used in the two-shaft hinge of the present invention. ~~First, in any~~In all of these examples, a hole 4, 7, 16, 18-1 into which the rotation shaft or the opening/closing shaft is inserted ~~are~~is in the form of a quadrangle, ~~and when being~~. When the hole 4, 7, 16, 18-1 is put around the shaft of a similar shape, the cams can move in

the axial direction but they are inhibited from rotating with respect to the shaft. The convex protrusion ~~(convex)~~ on the abutting surface is ~~formed from~~ provided so that the flat surface 4, 7, 16, 18-5 ~~through~~ and the inclined surface 4, 7, 16, 18-4 are formed. The shape of the convex protrusion ~~(convex)~~ 4, 7, 16, 18-3 formed on the cam--abutting surface can be a groove-like shape, a projection-like shape, or a circular shape ~~or the like~~, and the shape can be selected ~~and used~~ appropriately in accordance with the torque request such as the cam number ~~and/or~~ the setting angle.

**[0036]** ~~Fig. Figures~~ 7(a), 7(b), 7(c) and 7(d) show examples of the shape ~~effor~~ for the abutting surface of the rotating cam 3, 8, 15, 19 for the rotation torque generation and the opening/closing torque generation, which are used in the two-shaft hinge of the present invention. ~~First, in-~~ any In all of these examples, a hole 3, 8, 15, 19-1 into which the rotation shaft and the opening/closing shaft is inserted ~~are is a~~ is a circular ~~holes, and when~~ hole. When the hole 3, 8, 15, 19-1 is putting around the shaft ~~whose~~ of which cross--section is a deformed shape, the cams can rotate with respect to the shaft. The concave groove ~~(concave)~~ on the abutting surface is formed from the flat surface 3, 8, 15, 19-2 through the inclined surface 3, 8, 15, 19-4. The shape of concave groove ~~(concave)~~ 3, 8, 15, 19-3 formed on the cam abutting surface can be a groove-like shape, a projection-like shape, or a circular shape ~~or the like~~, and can be selected appropriately to employ in accordance with the torque request such as the cam number ~~and/or~~ the setting angle. On an outer periphery of the rotating cam, a protrusion 3, 8, 15, 19-6 ~~to be~~ are provided to be fitted and attached to the grooves 6-1, 6-2 of the case 6, 14 for the rotation shaft and the opening/closing shaft.

**[0036.1]** It is noted that the above-mentioned fixing cam and the rotating cam are examples, and other

~~aspects~~variations are also possible as long as a torque is generated on the abutting surface between the fixing cam and the rotating cam.

[0037] ~~Fig.~~Figure 8 shows an example ~~having,~~ wherein the rotating cams have the concave groove ~~(concave)~~ 3, 8, 15, 19-3 similar to the rotating cams shown in ~~Fig.~~Figure 7 and an outer periphery ~~(3, 8, 15, 19-8)~~ cut into an oval shape.

[0038] In the examples shown in ~~Fig. 6, Fig. 7 and Fig. 8~~Figures 6-8, the fixing cam 4, 7, 16, 18 forms a convex protrusion ~~(convex)~~ on the abutting surface, and the rotating cam 3, 8, 15, 19 forms a concave groove ~~(concave)~~ on the abutting surface. However, in the present invention, a~~the~~ concave groove ~~(concave)~~ may be formed on the fixing cam and a~~the~~ convex protrusion ~~(convex)~~ may be formed on the rotating cam ~~contrary~~. The abutting surface to form a~~the~~ protrusion and a~~the~~ groove is not limited to one side of the cam, and thus a~~the~~ cam in which the abutting surfaces ~~(a protrusion and a groove)~~ are formed on both sides of the cam as shown in the example of the rotating cam 15 in ~~Fig.~~Figure 9(a) can be used.

[0039] ~~Fig. 9 (a)~~Figure 9(a) is an example showing the two-shaft hinge of an ~~embodiment of claim 4 and claim 7~~the fourth and the seventh embodiments of the present invention, ~~three.~~ Three pairs of the torque generating portions for the opening/closing shaft (abutting surfaces of ~~15-24, 15-16, 18-19~~15 with 24, 15 with 16, 18 with 19) are mounted, and a waved plate spring 17-1 is ~~further~~ mounted. ~~Grooves~~ ~~(concaves)~~ are ~~formed on both side of rotating cam 15,~~ The fixing cams 16, 24 are abutted on ~~the both sides of the~~ rotating cam 15 in a sandwich ~~fashion, and abutting surfaces~~ are ~~provided and increased to three pairs with adding a right side generating portion, whereby the pattern.~~ On both sides of the rotating cam 15, the concave grooves are formed. Thus, the generating portions, together with three pairs of the

abutting surfaces, give more complex sliding and click torque generation position generating patterns at the opening/closing operation is applicable to more complex patterns. For example, a click position, which is an important part at opening/closing rotation, can be created so that a plurality of the click torques can also be generated within a with limited rotating angle angles.

**[0039.1]** Fig. 9 (b), (c) and (d) Figures 9(b), 9(c) and 9(d) show the convex protrusions (convexes) and the concave grooves (concaves) on the abutting surfaces of the fixing cam 24 and the rotating cam 15 used in Figure 9(a). Rotating The rotating cam 15 shows the an example that the angles of the concave grooves (concaves) on the front and back of the abutting surface are different by 90° as shown in Figures 9(c) and 9(d). The present invention, which enables the complex click operation by combining the angles forming of the protrusions of the fixing cams 16, and 24 and the angles forming of the concave grooves (concaves) formed on both sides of the rotating cam 15, also enables an operation which cannot be realized equally by one pair of the rotating and the fixing cams, and. The present invention is extremely effective in enhanced durability against wear and tear which occurs on the cam-abutting surface at the torque generation and in stability of the torque, whereby a long-life hinge without wearing away can be realized.

**[0040]** Fig. 10 (a) Figure 10(a) is an example showing the two-shaft hinge of an the sixth embodiment of claim 6 of the present invention, and wherein a stopper mechanism to limit the rotating angle of the opening/closing shaft 12 is mounted. The angle limiting stopper mechanism is achieved by abutting the protrusion 12-5 of the opening/closing shaft 12 on the protrusion 9-6 provided in the hinge housing 9.

**[0040.1]** Fig. 10 (b) Figure 10(b) shows an example in which the protrusion 12-5 is provided in a part of a flange 12-3 of

the oval-shaped center part 12-1 in the opening/closing shaft ~~12-112~~, and a both-side portion 12-6 of the protrusion 12-5 is abutted on a both-side portion 9-7 of the protrusion 9-6 provided in the hinge housing 9. ~~Drawing Figure 9(b)~~ shows ~~thean~~ example in which the protrusion 12-5 of the opening/closing shaft 12 is formed across approximately 30°, the protrusion 9-6 of the hinge housing 9 is formed across approximately 60°, and the rotation shaft ~~1211~~ can rotate through approximately 270°.

**[0041]** ~~Fig. Figure~~ 11 shows an appearance of the hinge housing 9 used in the present invention. ~~Hole~~A hole 9-6, a bottom 9-10 and a groove 9-8 are formed in the middle, a ~~through-holes (9-7 through 9-1)~~ are hole 9-1 is formed in the left section, and an insertion hole 9-2 of the opening/closing shaft torque unit 23 is formed in the right section.

**[0042]** ~~Fig. 12 (a) and (b)~~ Figures 12(a) and 12(b) show the rotation shaft 11. The shaft has a penetrating hole 11-1, a step 11-2 to which the caulking ring 1 is put around and fixed, a square surface 11-3, 11-4 fitted with the fixing cam 4, 7, a circular surface 11-4 which rotates after the rotating cams 3, 8 are put around, and a fixing flange 11-5.

**[0043]** ~~Fig. Figure~~ 13 is an example showing the two-shaft hinge of the tenth and the eleventh embodiments ~~of claim 10 and claim 11~~ of the present invention. The figure shows an example ~~in which a component,~~ that the rotating cam 8 of the rotation torque generating portion is omitted ~~and to~~ reduce the height of the two-shaft hinge. Instead, a ~~rotating cam an additional member 8-7 is incorporated so that a molded as a different member and sharing bottom 9-10 of the hinge housing 9 is incorporated for the purpose of reducing the height of the two-shaft hinges~~ shared with the member 8-7. By using the ~~different~~ additional member, not only can the number of the components ~~can be~~ reduced but also the strength

of the hinge can be enhanced. The rotation torque unit shown in ~~Fig.~~Figure 13 shows ~~the an~~ example of a structure in which a stop ring 1-2 is assembled to one side of the rotation shaft 11 so that the rotation torque unit 22 can be ~~composed~~assembled in the offline setup.

**[0044]** ~~Fig. 14 and Fig.~~Figures 14 and 15 are examples showing the two-shaft hinge of ~~an~~the second embodiment of ~~claim 2~~ of the present invention. ~~Fig.~~Figure 14 shows an example in which the rotation torque generating portion is mounted on a lower portion of the coil spring 5. ~~Fig.~~Figure 15 shows an example in which the rotation torque generating portion is mounted on an upper portion of the coil spring 5. The rotation torque unit 22 is ~~obtained~~assembled by inserting the rotation shaft 11 into a pair of the fixing cam 4.7 and the rotating cam ~~(7, 8) or (3, 4)~~3, 8, and the coil spring 5 ~~and~~. Then, the rotation torque unit 22 is caulking-fixed by the caulking ring 1. The present invention can be employed in a case of reducing the space or the height of the upper portion ~~22~~ of the rotation torque unit 22 as shown in ~~Fig.~~Figures 14 and ~~Fig.~~Fig. 15.

#### BRIEF DESCRIPTION OF THE DRAWINGS

**[0045]** ~~[Fig. 1] This is a partial cross-sectional front view showing an example of embodiments of the inventions of claim 1, claim 8 and claim 12;~~

~~[Fig. 2] Fig. 2 is a component configuration diagram showing an example of embodiments of the inventions of claim 1, claim 5, claim 6, claim 11, and the like;~~

~~[Fig. 3] (a) is a top view, (b) is a front view, (c) is a bottom view, (d) is a left side view, and (e) is a right side view, each showing an embodiment of the inventions of claim 1, claim 6, claim 8, and claim 12;~~

~~[Fig. 4] This is a partial cross-sectional front view showing an embodiment of the invention of claim 7;~~

~~{Fig. 5} This is a partial cross-sectional front view showing an embodiment of the invention of claim 3;~~

~~{Fig. 6} This is a componential drawing of fixing cams of the rotation and the opening/closing torque generating portions which are used in the present invention;~~

~~{Fig. 7} This is a componential drawing of rotating cams of the rotation and the opening/closing torque generating portions which are used in the present invention;~~

~~{Fig. 8} This is a componential drawing of rotating cams of the rotation and the opening/closing torque generating portions which are used in the present invention;~~

~~{Fig. 9} These show an embodiment of claim 4 and claim 7, in which (a) is a partial cross-sectional view, the upper figures of (b) (c) and (d) are partial plan views of a fixing cam and a rotating cam, and the lower figures of (b) (c) and (d) are cross-sectional views of same;~~

~~{Fig. 10} (a) is a cross-sectional view and (b) is a component configuration diagram, each showing an embodiment of claim 6;~~

~~{Fig. 11} This shows an appearance of a hinge housing used in the present invention;~~

~~{Fig. 12} (a) is a front view and (b) is a top view, each showing an aspect of the rotation shaft used in the present invention;~~

~~{Fig. 13} This is a partial cross-sectional front view showing an embodiment of the inventions of claim 10 and claim 11;~~

~~{Fig. 14} This is a partial cross-sectional front view showing an embodiment of the invention of claim 2;~~

~~{Fig. 15} This is a partial cross-sectional front view showing an embodiment of the invention of claim 2; and~~

~~{Fig. 16} This is a front view showing a conventional example.~~

DESCRIPTION OF REFERENCE NUMERALS

- ~~1~~ — ~~caulking ring~~
- ~~2~~ — ~~lubricating ring for rotation shaft~~
- ~~3,8~~ — ~~rotating cam for rotation shaft (concave cam)~~
- ~~4,7~~ — ~~fixing cam for rotation shaft (convex cam)~~
- ~~5~~ — ~~coil spring, disc spring for rotation shaft~~
- ~~6~~ — ~~case for rotation shaft~~
- ~~9~~ — ~~hinge housing~~
- ~~10~~ — ~~fixing base~~
- ~~11~~ — ~~rotation shaft~~
- ~~12~~ — ~~opening/closing shaft~~
- ~~13~~ — ~~lubricating ring for opening/closing shaft~~
- ~~14~~ — ~~case for opening/closing shaft~~
- ~~15,19~~ — ~~rotating cam for opening/closing shaft (concave cam)~~
- ~~16,18~~ — ~~fixing cam for opening/closing shaft (convex cam)~~
- ~~17~~ — ~~coil spring for opening/closing shaft~~
- ~~20~~ — ~~plug~~
- ~~21~~ — ~~fixing pin~~